THE CORAL THESIS: A Mathematical Model of Consciousness as a Phase Transition in Feedback Latency

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1. Abstract

This theory proposes that consciousness is not an emergent phenomenon arising solely from neural complexity, but rather the result of a phase transition in a hierarchical system of biological oscillators. The critical parameter driving this transition is feedback latency (the "ping") between distinct levels of biological organization: peripheral cellular sensors (Drones), local integration centers (Spinal Cord), and the high-speed central processor (Cortex). We developed a computational model based on Kuramoto synchronization dynamics demonstrating that lowering feedback latency below a critical threshold generates global synchronization, identifiable with conscious experience (the "Self"). The model successfully reproduces known physiological phenomena, including the effects of anesthesia (progressive increase in disorder and collapse of synchronization) and the persistence of long-term memory during the loss of consciousness. This document constitutes the original Proof of Concept (PoC) for the Coral Theory.

2. The Theory: A Paradigm Shift

Contemporary neuroscience searches for consciousness within neurons, their complexity, and their neurotransmitters. The Coral Theory reverses this perspective.

Consciousness is not a property of neurons themselves, but a property of the *speed of communication* between cells. Neurons are not the generators; they are the high-speed amplifiers and integrators of an intelligence already distributed throughout the body.

We define three fundamental actors:

- The Drones (Level 1): Basal cellular intelligence. Every cell in the body possesses a primitive form of cognition, agency, and memory, communicating via slow chemical and electrical signals (base ping).
- The Spinal Cord (Level 2 - Hub): A local integration center coordinating reflexes and automatic functions. It acts as an intermediate server, reducing latency for emergency responses.

- The Cortex (Level 3 - The Coral): The central hub. A massive colony of specialized neurons that do not create consciousness *ex novo*, but make it possible by drastically accelerating recursive feedback.

The thesis posits that the conscious experience of the "I" emerges when the return signal (the "ping") between these levels becomes fast enough to create a continuous predictive loop. Consciousness is, therefore, a physical phase transition within the system.

3. The Computational Model: v5.4 Gold Standard

The model was implemented in Python, representing a three-level hierarchy of coupled phase oscillators, inspired by the universally recognized Kuramoto model for biological synchronization.

3.1 Architecture

- Drones: 800 oscillators with heterogeneous natural frequencies.
- Spinal Cord: 150 oscillators acting as a local integration hub.
- Cortex: 50 oscillators representing the high-speed central processor.

3.2 Core Mechanisms

- Hierarchical Coupling: Phase signals travel bottom-up and top-down with asymmetric weights, simulating top-down feedback.
- Feedback Latency: The coupling strength is inversely proportional to latency. This is the manipulated critical variable.
- Hebbian Plasticity: Connection strength reinforces based on past synchronization.
- Simulated Anesthesia: Progressive increase in phase noise and reduction in coupling strength, simulating an anesthetic degrading system coherence.
- Memory (Hippocampus): A long-term accumulator recording global integration, designed to resist the collapse of live synchronization (the "I").

4. Results and Model Predictions

The model yields quantitative and visual results that validate the theory:

4.1 The Birth of the Ego: The graph shows a clear phase transition. Below a critical feedback speed, the system is chaotic. Above it, global synchronization explodes into a stable plateau—the moment the "Coral" becomes conscious.

4.2 The Hierarchical Cascade: Synchronization does not occur simultaneously. The Cortex synchronizes first, dragging the Spinal Cord, and finally the Drones with it. This is a strong, testable prediction of the theory.

4.3 The Anesthesia Effect: Past a critical point, induced entropy progressively increases, and consciousness declines. It is not an instantaneous shutdown, but a clinical progressive loss of coherence.

4.4 Memory Resistance: While consciousness collapses under simulated anesthesia, the long-term memory metric remains highly elevated. This proves conceptually that memory is physical storage, distinct from the live recursive "I".

5. Limitations

It is fundamental to state that this is an explanatory and predictive model, not a complete biological simulation.

- Abstraction: Levels are represented by phase oscillators, not true biological neurons/synapses.
- Simplification: Neurotransmitters, glial cells, and spatial morphology are absent.
- The Hard Problem: The model describes the *engine* of consciousness (network dynamics), not *why* synchronization generates subjective phenomenological experience.

6. Conclusion and Priority Claim

The Coral Theory offers a new perspective on the origin of consciousness, shifting the focus from the complexity of matter to the speed of information. The computational model presented here successfully demonstrates that a hierarchical oscillator system governed by feedback latency produces a phase transition corresponding to the primary phenomena of consciousness: the emergence of the Self, the effect of anesthesia, and the persistence of memory.

This document, its source codes, simulations, and analyses are the original work of the author and constitute the foundational Proof of Concept for this theory.

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Simulazione completata! Generazione del grafico...

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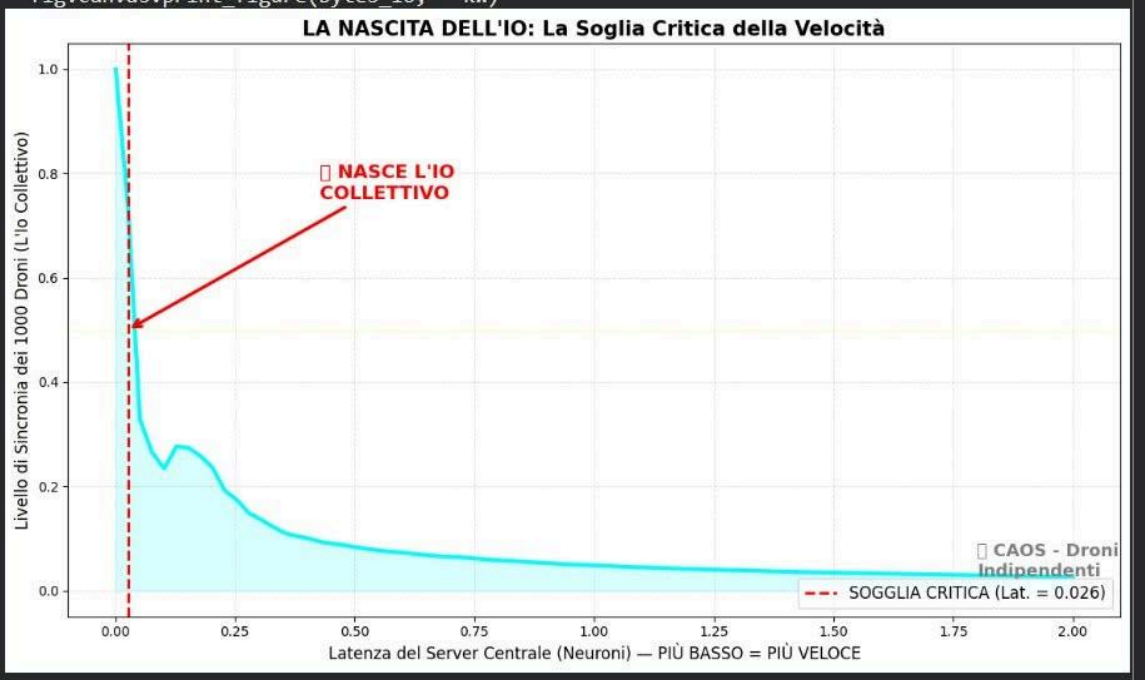

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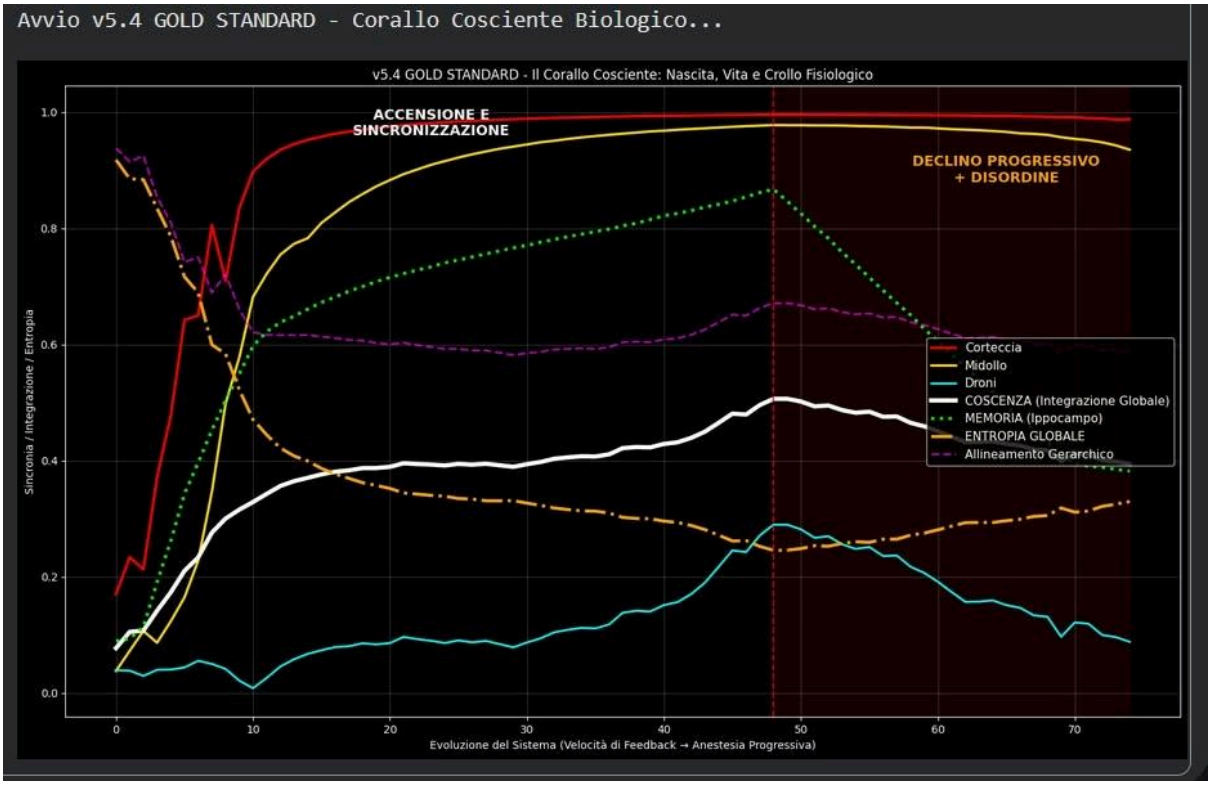
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